The role of interactions in Science learning using three educational mediums: video, technology-based learning environment and real objects

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Abstract

In this paper we discuss the interactions between students and among teacher and students. It is pedagogic delusion the thought that the work of students in groups involves automatically their collaboration (Amigues, 1988). The interaction between students depends among other things on their personality (Kempa and Ayob, 1991). Many times, their oppositions lead them to conflicts that prevent the problem's solution (Goffard and Goffard) or a student with an error representation accomplishes to convince the other (Gomatos, 1996). Dillenbourg (1999) states that students do not learn from each other merely by solving the same problem at the same time, but because they interact (e.g. by explaining something or by negotiating about several solutions).The teacher's role as tutor is very important (Dumas-Carr? & Weil-Barais, 1998).

The innovative paradigm concerns Science teaching and specifically Hooke's Law. It exploits three different mediums: a video, real objects and the technology-based learning environment "ModellingSpace". First, students look at a video. A spring is in its equilibrium position (neither compressed nor extended). The length is perturbed slightly and the spring tends to come back to the equilibrium position. Then a mass is hung from the spring and it is displaced from the equilibrium position and so on. They describe and explain the video, expressing their first representations. Next, they carry-out the experiment using everyday objects. Finally, they design and virtually run the experiment using "ModellingSpace" which is an open-ended learning environment that allows students to create models. Results show that the use of three media and the cooperation between students and among teacher and students facilitates students' understanding in a more intuitive way, particularly concerning the meaning of abstract concepts.

Extended Summary

In this paper we discuss the interactions between students and among teacher and students. It is pedagogic delusion the thought that the work of students in groups involves automatically their collaboration (Amigues, 1988). The interaction between students depends on their personality (Kempa and Ayob, 1991). Many times, their oppositions lead them to conflicts that prevent the problem's solution (Goffard and Goffard) or a student with an error representation accomplishes to convince the other students (Gomatos, 1996). Dillenbourg (1999) states that students do not learn from each other merely by solving the same problem at the same time, but because they interact (e.g. by explaining something or by negotiating about several solutions).The teacher's role as tutor is very important (Dumas-Carré & Weil-Barais, 1998).

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Based on the presented theoretical framework, we discuss the interactions between students and among teacher and students in Science teaching. Specifically, the teaching paradigm concerns Hooke's Law using springs. The physical system we study has certain advantages: it is simple enough and represents a wide spectrum of real systems in order to be as reusable as possible. The paradigm is designed within a socio-constructivist approach, where the student takes an active role on the construction of his/her knowledge, and it exploits three different mediums: a video in order to motivate students' interest; objects from everyday life for the experiments; the learning environment "ModellingSpace".
First, students look at a video. A spring neither compressed nor extended is in its equilibrium position. The length is perturbed slightly and the spring tends to come back to the equilibrium position. As long as the deformation is elastic, the force exerted by the spring will be proportional to the amount of the stretch from equilibrium. Then a mass is hung from the spring, it is displaced from the equilibrium position and it oscillates. The students describe and explain the video, expressing their first representations. Next, they carry-out the experiment using different springs. Finally, they design and virtually run the experiment using "ModellingSpace" (Dimitracopoulou et al., 1999; Komis et al., 2001).

ModellingSpace is a technology based open-ended learning environment, currently in the state of prototype (Dimitracopoulou et al., 1999; Komis et al., 2001), designed to familiarize students with the steps of modelling that allows students to create models, work and reflect on entities (representing objects) and their properties (representing concepts), while they construct the model of the situation using entities (concrete or abstract), their properties and relations between the properties. Using the above mentioned learning environment, the students can build models of the evolution of physical, biological, chemical systems, etc. Concretely, the user of the learning environment determines the constitutive entities of the system in which he is interested and the descriptors of these entities. Then he proposes relations between these possible descriptors to account for the evolution of the system.
The interest of this learning environment is that it makes possible to students to handle various semiotic systems, making possible to express the entities and the relations between their properties. By comparing the transformations of the entities (represented in a figurative way by dynamic images) associated with various expressions of the relations, it is possible to apprehend the compatibility or the incompatibility of the relational expressions. It is thus possible to exploit the possible mapping between various manners of representing the relations: graphic coding with arrows of variable size (↑↑ which means the co variation of two descriptors), logical, mathematical expression, a graph, and a table of measurements. ModellingSpace (Komis et al., 1998; Politis et al., 2001) thus make possible to students to connect various symbolic notations of relations between variables and thus encourage various processes of translation between the various semiotic systems (language, semi-quantitative relations, etc).

We compared the models created by the students using the ModellingSpace in the tree phases. When they:

1) work individually
2) work in groups and each group was implemented separately
3) work in groups which was implemented separately and their teacher participate also to the processus.

Students attended first grade of higher-secondary school (15-16 years old). Each group consisted of three students. The developed teaching approach was implemented with 15 students in the first phase, 5 groups (or 15 students) in the second phase and 5 groups (or 15 students) and their teachers in the third phase. The duration of the implementation was 20-30 minutes for each individual while the duration of the implementation was 30 - 40 minutes for each group. The students had volunteered to participate. The implementation of the paradigm was video-recorded, while some of them were also interviewed afterwards.

Results show that the use of three media and the cooperation between students and among teacher and students facilitates students' understanding in a more intuitive way, particularly concerning the meaning of abstract concepts. When the students work in groups, the most of times grouping helps them and they arrive to agree and to measure the elongation from the correct position. Of course, the interactions between the students as well as the role that each student plays in the group are very interesting. Nevertheless, there are some groups (minimal) where a student has the role of leader or there are disagreements and they don't arrive in the correct result. In case that their teacher participates in the process ,he prompts them to experiment more times and "carefully'. The teacher asks them many questions but he/she also helps them when the students answer by a false response. For example "*do you remind anything… we have taught it in the book…* Or they say: *it exists in a frame with the spring and the dynamometer in the chapter 2… I help you*"; "*Beautifully! you have meet it in the lower secondary school and you have given it also a name*". We conclude that in case students work in groups positively and the teacher participates to the process then the models created are more complicated and the students arrive to build the scientific model.